

REMARKS

Regarding the status of the present application, Claims 1-9, 21 and 22 have been amended, and Claims 1-20 are pending in this application. Reconsideration of this application is respectfully requested.

Claims 1-5 and 8-18 were rejected under 35 U.S.C. § 103(a) as being unpatentable over US Patent No. 6,388,786 issued to Ono et al. in view of US Patent No. 424,444 issued to Kahn et al. and further in view of U.S. Patent No. 6,389,081 issued to Shimizu et al. or in view of U.S. Patent No. 5,222,103 issued to Gross et al. It is respectfully submitted that the Examiner's position is in error.

The present invention provides for a transmitter comprising a programmable optical vector modulator that may be used in coherent optical communication systems. An exemplary programmable optical vector modulator comprises a transmitter laser for providing a laser beam output that is processed by a series-coupled amplitude modulator and phase modulator that are used to modulate the beam into an arbitrary amplitude/phase state. Amplitude and phase state constellation generating circuitry are coupled to the optical amplitude and phase modulators that are responsive to input data and a data clock signal. The amplitude and phase constellation circuitry produces programmable voltage signals that are input into the amplitude and phase modulators.

The present invention may be used to maximize the data transmitted over an optical link with varying nonlinearity and varying optical signal to noise ratio. The present invention generates arbitrary M-ary amplitude and phase state constellations that allows multiple bits/symbol and/or predistortion of the constellation to compensate for link non-idealities. The programmable nature of the present invention allows the constellation to be changed through the use of software only, without any changes in hardware. The transmitter can maximize the data rate to take full advantage of whatever optical dynamic range is currently available. The transmitter can also variably predistort the constellation to compensate for varying link distortion, in particular the nonlinear effect commonly known as "self-phase modulation".

More specifically, the present invention employs constellation generating apparatus that generates an arbitrary M-ary amplitude modulated and/or phase shift keyed constellation of data points that are input to the amplitude and phase modulator to amplitude and phase modulate the laser beam (see Fig 2, for example). In addition, the present invention implements predistortion of the constellation (see Figs. 6 and 7, for example). These aspects of the present invention are not disclosed or suggested in the cited references.

It is respectfully submitted that these concepts are not disclosed or suggested by the cited references, taken singly or together. More specifically, it is respectfully submitted that the Examiner's has combined the cited references using hindsight reconstruction, using the teachings of the cited references in light of Applicant's own teachings.

The Ono et al. patent discusses duobinary on-off keying along with intensity and phase modulation of an optical signal. The Ono patent discusses a fixed point constellation, namely

QPSK modulation. There is no disclosure or suggestion in the Ono patent regarding generating an arbitrary M-ary amplitude modulated and/or phase shift keyed constellation of data points, or predistorting such a constellation.

The Kahn et al. patent discusses duobinary multi-level pulse amplitude modulation of an optical signal. There is no disclosure or suggestion in the Kahn patent regarding generating an arbitrary M-ary amplitude modulated and/or phase shift keyed constellation of data points, or predistorting such a constellation.

The Shimizu et al. patent discusses QPSK RF modulation of an optical signal. The constellation consists of four points. There is no disclosure or suggestion in the Shimizu patent regarding generating an arbitrary M-ary amplitude modulated and/or phase shift keyed constellation of data points, or predistorting such a constellation.

The Gross et al. patent discusses QPSK RF modulation of an optical signal. The constellation consists of four points. There is no disclosure or suggestion in the Gross patent regarding generating an arbitrary M-ary amplitude modulated and/or phase shift keyed constellation of data points, or predistorting such a constellation.

Independent Claim 1 calls for a programmable system for transmitting an arbitrary M-ary modulated optical signal comprising:

"constellation generating apparatus that is responsive to input data and a data modulator clock signal for generating an arbitrary M-ary amplitude modulated and/or phase shift keyed constellation of data points that are input to the amplitude and phase modulator to amplitude and phase modulate the laser beam."

It is respectfully submitted that there is no disclosure or suggestion contained in the cited patents, taken singly or together, which provides for this aspect of the present invention. It is also respectfully submitted that in order to reject Claim 1, the Examiner has extended the teachings of the cited references and has used hindsight reconstruction, using the teachings of the cited patents in light of Applicant's own teachings.

In view of the above, it is respectfully submitted that the Ono et al., Kahn et al., Shimizu et al. or Gross et al. patents, taken singly or together, do not disclose or suggest the invention recited in Claim 1, and certainly not without the use of hindsight reconstruction. Withdrawal of the Examiner's rejection and allowance of Claim 1 are respectfully requested.

Dependent Claims 2-5 and 8 are considered patentable based upon the allowability of Claim 1. Therefore, it is respectfully submitted that the invention recited in Claims 2-5 and 8 are not disclosed or suggested by the Ono et al., Kahn et al., Shimizu et al. or Gross et al. patents, taken singly or together. Withdrawal of the Examiner's rejection and allowance of Claims 2-5 and 8 are respectfully requested.

Independent Claim 9 calls for an optical transmitting method comprising the steps of:

outputting a laser beam;

generating an arbitrary M-ary constellation of data points in response to input data and a data clock signal that are used to amplitude and phase modulate the laser beam;
amplitude modulating the laser beam using the arbitrary M-ary constellation of data points;
delaying the arbitrary M-ary constellation of data points used for phase modulation to synchronize it with the amplitude modulated laser beam;
phase modulating the amplitude modulated laser beam using the delayed arbitrary M-ary constellation of data points to produce a modulated output beam.

It is respectfully submitted that none of the cited patents, taken singly or together, disclose or suggest "generating an arbitrary M-ary constellation of data points in response to input data and a data clock signal that are used to amplitude and phase modulate the laser beam", or any of the other processing steps relating to the arbitrary M-ary constellation of data points,

In view of the above, it is respectfully submitted that the Ono et al., Kahn et al., Shimizu et al. or Gross et al. patents, taken singly or together, do not disclose or suggest the invention recited in Claim 9, and certainly not without the use of hindsight reconstruction. Withdrawal of the Examiner's rejection and allowance of Claim 9 are respectfully requested.

Dependent Claim 10 is considered patentable based upon the allowability of Claim 9. Therefore, it is respectfully submitted that the invention recited in Claim 10 is not disclosed or suggested by the Ono et al., Kahn et al., Shimizu et al. or Gross et al. patents, taken singly or together. Withdrawal of the Examiner's rejection and allowance of Claim 10 is are respectfully requested.

Independent Claim 11 calls for a programmable system for transmitting an arbitrary M-ary modulated optical signal comprising:

a constellation generating apparatus for generating an amplitude control signal and a phase control signal from an input data signal, wherein the amplitude control signal is input to the amplitude modulator and the phase control signal is input to the phase modulator, together the amplitude control signal and the phase control signal comprising an arbitrary M-ary constellation of data points such that the amplitude and phase-modulated optical signal is an arbitrary M-ary modulated optical signal.

Specifically, none of the cited patents address constellation generating apparatus that generates an arbitrary M-ary constellation of data points. For the reasons discussed above, it is respectfully submitted that there is no disclosure or suggestion contained in the cited patents, taken singly or together, which provides for this aspect of the present invention. It is also respectfully submitted that in order to reject Claim 11, the Examiner has extended the teachings of the cited references and has used hindsight reconstruction, using the teachings of the cited patents in light of Applicant's own teachings.

In view of the above, it is respectfully submitted that the Ono et al., Kahn et al., Shimizu et al. or Gross et al. patents, taken singly or together, do not disclose or suggest the invention recited in Claim 11, and certainly not without the use of hindsight reconstruction. Withdrawal of the Examiner's rejection and allowance of Claim 11 are respectfully requested.

Dependent Claims 12-18 are considered patentable based upon the allowability of Claim 11. Therefore, it is respectfully submitted that the invention recited in Claims 12-18 are not disclosed or suggested by the Ono et al., Kahn et al., Shimizu et al. or Gross et al. patents, taken singly or together. Withdrawal of the Examiner's rejection and allowance of Claims 12-18 are respectfully requested.

Claims 6, 7, 19 and 20 were rejected under 35 U.S.C. § 103(a) as being unpatentable over US Patent No. 6,388,786 issued to Ono et al. in view of US Patent No. 424,444 issued to Kahn et al. and further in view of U.S. Patent No. 6,389,081 issued to Shimizu et al. or in view of U.S. Patent No. 5,222,103 issued to Gross et al. , and further in view of U.S. Pub. 20030012289 of Lindoff. It is respectfully submitted that the Examiner's position is in error.

It is respectfully submitted that the Ono et al., Kahn et al., Shimizu et al. or Gross et al. patents, taken singly or together do not disclose or suggest anything regarding predistortion of a constellation. The fact that the Lindoff publication discusses predistortion is irrelevant to the teachings of the cited patents. Clearly, there is no teaching contained in the cited references that would suggest their combination. The has only been achieved using improper hindsight reconstruction on the part of the Examiner.

Therefore, it is respectfully submitted that the invention recited in Claims 6, 7, 19 and 20 are not disclosed or suggested by the Ono et al., Kahn et al., Shimizu et al. or Gross et al. patents, in combination with the Lindoff publication, taken singly or together. Furthermore, dependent Claims 6, 7, 19 and 20 are considered patentable based upon the allowability of Claims 1 and 11 from which they depend. Therefore, withdrawal of the Examiner's rejection and allowance of Claims 6, 7, 19 and 20 are respectfully requested.

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure to the extent indicated by the Examiner.

In view of the above, it is respectfully submitted that the present application is in condition for allowance. Reconsideration and allowance of this application are earnestly solicited.

Respectfully submitted,



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